'True' Blue Sky - Ian Wilson PhD (Optics)

Sometimes when we capture bird images, some or all of the background is blue sky. This is often the case, for example, when we photograph birds in flight. Depending upon the exposure and how the image is subsequently processed, the blue sky can look un-natural to the extent that it spoils what might otherwise be a pleasing image. A few examples of un-natural looking blue sky taken from recent posts to the BLP gallery are shown in Figure 1. Two of these were 'snipped' from the Best of 2017, Advanced Level competition.

Figure 1. Some recent examples posted to the BLP gallery of un-natural looking blue sky.

This article is about the nature of blue sky and how to achieve a natural-looking blue sky in a finished image. I'll start with a brief discussion of what makes a clear, daytime sky, appear blue. This comes about because the red, green and blue components of the light from the sun interact differently with the Earth's atmosphere. Most of the red light passes straight through the atmosphere as direct sunlight, while much of the blue light is scattered out of the direct sunlight by nitrogen and oxygen molecules in the atmosphere. The blue light is scattered about ten times as much as the red light; this phenomenon is known as Rayleigh scattering. The blue light is scattered multiple times and eventually reaches the Earth's surface from directions throughout the hemisphere above the observer including as far over as the horizon. So no matter where the observer looks in the sky, it will appear a shade of blue. The darkest blue will appear roughly overhead and will be brighter (paler) towards the horizon where all colours are scattered by about the same amount if there are particles in the atmosphere with size similar to the wavelength of light such as water droplets, dust, smoke and salt particles. This is known as Mie scattering; it adds a component of white light to the blue from Rayleigh scattering, with the overall effect that the sky near the horizon is pale blue or in some cases there can be so much Mie scattering that the sky can appear almost white. The contribution from Mie scattering increases towards the horizon as the effective thickness of the atmosphere along the line of sight increases. The total light observed at a particular elevation (θ) is the sum of the blue light due to Rayleigh scattering and the white light due to Mie scattering.

Total Light (at elevation θ) = Rayleigh (blue light) + Mie (white light)

Figure 2 illustrates how the shade of blue becomes lighter with the addition of white light due to Mie scattering. You can check this out for yourself by creating a new image in Photoshop Elements or Photoshop and making a square selection about 500 × 500 pixels; then set the foreground colour to R = 98, G = 122 and B = 157 digital numbers (DN) in the Color Picker window, and fill the selection with the Paint Bucket tool (keyboard shortcut **G** (PS) or **K** (PSE)). Then increase the brightness (Enhance | Adjust Lighting |

Brightness/Contrast… in PSE, or Image | Adjustments | Brightness | Brightness/Contrast… in PS) and watch what happens. Increasing the brightness is the equivalent of adding white light (from Mie scattering) to the blue sky near the horizon. This will be a useful exercise to give you a 'feel' for the range of blues that are commonly observed in the sky.

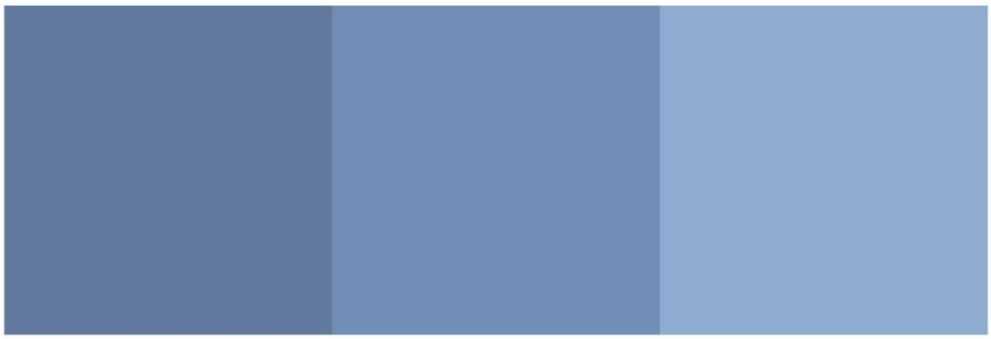


Figure 2. Illustrating how the appearance of blue sky changes from overhead (left panel) to the horizon (right panel) depending upon how much Mie scattering there is from aerosols in the atmosphere.

When we capture an image containing blue sky the appearance of the blue will depend on the exposure, with underexposure resulting in a dark blue while overexposure will result in a brighter, paler blue. It is rare for the exposure of the blue sky background to be just right as we usually set the camera to give correct exposure for the bird. Then there is the white balance selected to suit the lighting conditions; the main white balance adjustment changes the proportion of blue and red in the image. Finally, we use a pre-set Picture Style which will affect the amount of saturation. If we choose the exposure, white balance and Picture Style to be optimal for the bird, then there is a good chance that the blue sky will have an un-natural appearance like in the examples shown in Figure 1.

It is possible to get 'all the ducks lined up' in some simple situations such as when photographing white seabirds in direct sunlight against a blue sky. The white upper parts of the bird in direct sunlight can be used to set the exposure with reference to the highlight alert (blinkies) and if the white parts are a neutral white, then they can be used to fine-tune the white balance in post-processing. The remaining variable is the Picture Style which will give the most accurate rendering of blue sky if set to Neutral. In the Canon camera system there is also Picture Style = Standard which sounds alright, but it adds saturation and makes the sky appear a more vivid blue than in reality. If you are a landscape photographer and use Picture Style = Landscape be aware that there will be even more saturation; this helps explain the many landscape pictures with surreal, vivid colours that are so much in vogue these days. Bird photographers usually aim to render subjects as natural as possible so that their images can serve as identification references. In general, we should resist the temptation to crank up the saturation or vibrance except in cases where a high ISO was used to capture the image, in which case a little saturation (about 10 units in Photoshop) can help make up for lower colour dynamic range.

I mentioned that it is almost inevitable that the blue sky will have an un-natural appearance in many images. That begs the question; what can we do about it? If you take the trouble in post-processing to select the bird and separately adjust the lighting and colour of the bird

and the background, then it is possible to achieve the desired outcome. To do this we need to know the RGB numbers for a natural looking blue sky and believe it or not there is a blue sky standard to help us. It will not be perfect because it is for overhead blue sky in mid-latitudes near sea-level. However, except at high altitude, it is the darkest blue we can anticipate so it is useful in setting an acceptable limit. The RGB values for this standard are **R = 98, G = 122 and B = 157** DN. In the absence of Mie scattering, the shade of blue due to Rayleigh scattering varies little with elevation. Closer to the horizon there is invariably a contribution due to Mie scattering and a paler blue is more appropriate, which can be achieved by increasing the brightness of the blue sky standard; this is the equivalent of adding more white light from Mie scattering. In Photoshop Elements we make these adjustments on the blue sky background using a combination of lightness and saturation in the Adjust Color | Adjust Hue/Saturation… option under the Enhance tab (see Figure 3), in Photoshop use Image | Adjustments |. Hue/Saturation…; or use the same keyboard shortcut Ctrl-U in either PSE or PS.

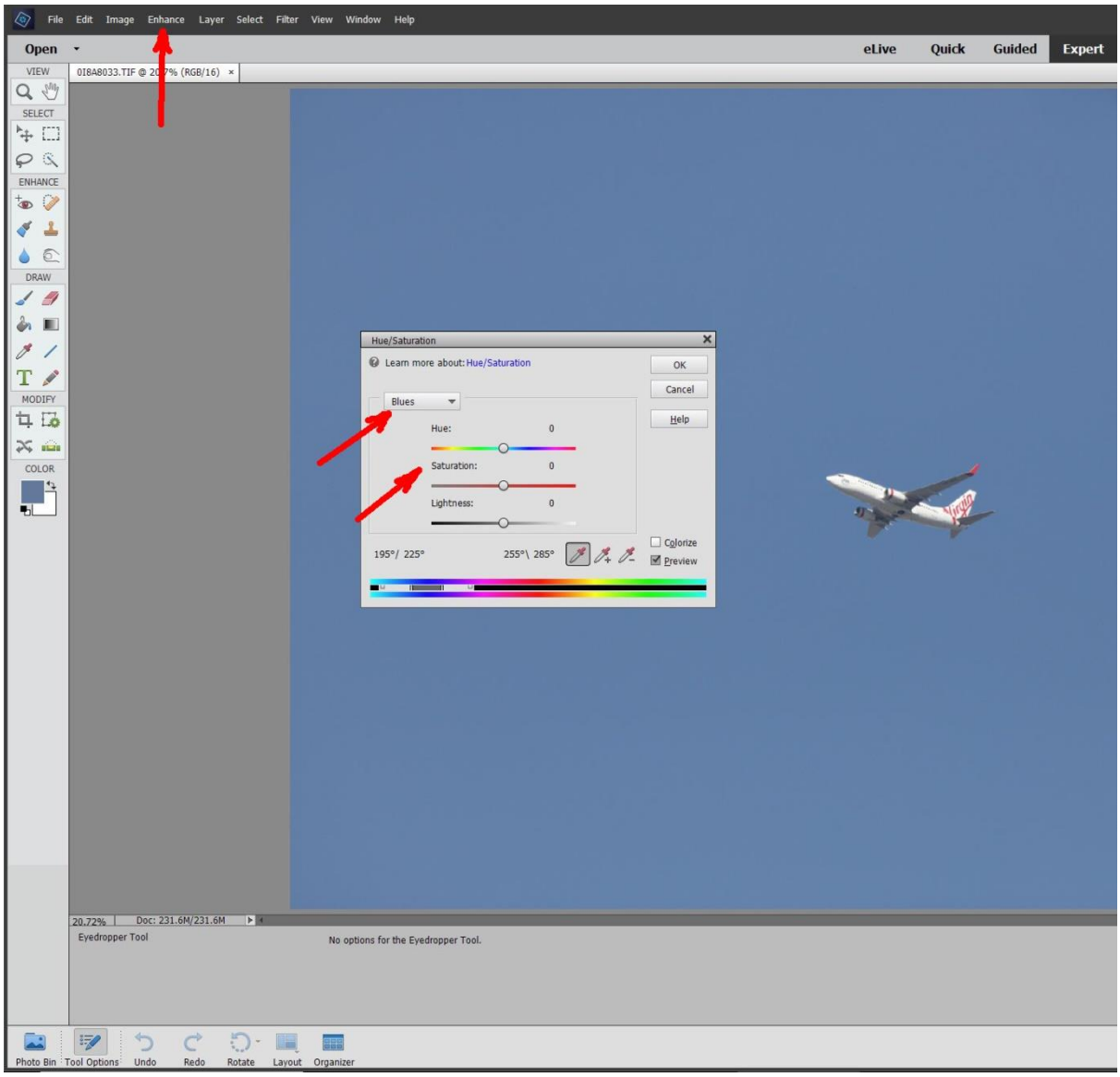
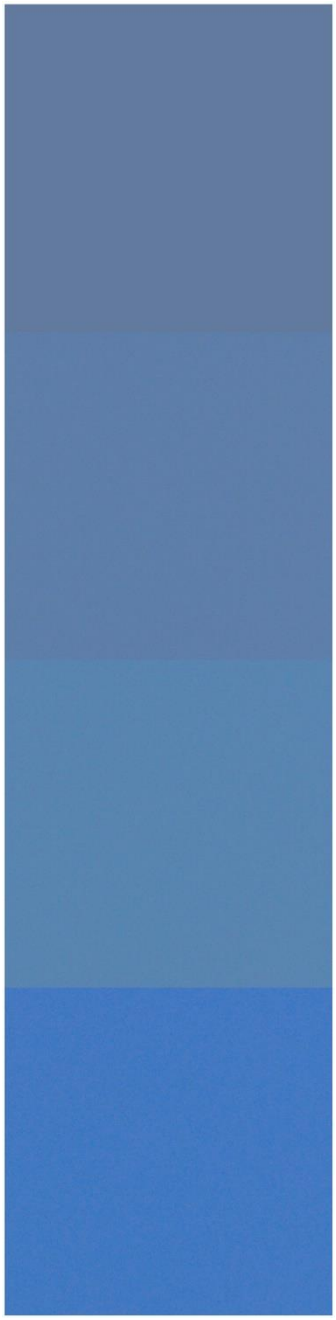


Figure 3. Showing the Photoshop Elements tools required to adjust the blue and cyan saturation on the background selection.

Before adjusting the blue sky we first need to check the sky RGB numbers. In both Photoshop Elements and Photoshop we do this by clicking on the Window tab on the top tool-bar and opening the Info option, or use the keyboard shortcut F8; this will display the RGB numbers under the cursor as we roam across the image. If the numbers are lower than for the blue sky standard, then the sky will appear too dark and we need to increase the brightness of the background selection and fine tune the blue and cyan saturation in the Hue/Saturation window to get RGB numbers similar to the blue sky standard. If the sky RGB numbers are higher (brighter sky) than the blue sky standard it is likely to be due to Mie scattering. We can check for this by subtracting the standard RGB numbers from the measured RGB numbers. Light due to Mie scattering is mainly white light so the difference in RGB numbers should be about the same in each colour channel. If this is the case then the measured blue sky will be natural looking and all's well. In the following example the measured RGB numbers were R = 148, G = 169 and B = 211 DN. We then subtract the blue sky standard RGB numbers as follows: R = 148 – 98 = 50, G = 169 – 122 = 47 and B = 211 – 157 = 54 DN. The difference between the measured RGB numbers and the blue sky standard is about the same (approx. 50 DN) for each colour channel so we can be confident that the blue sky in our image will look natural. If the difference between the measured RGB numbers and the blue sky standard is not about the same in each colour channel, then we need to adjust the blue and cyan saturation until this condition is approximately satisfied.

I thought it would be interesting to give a practical demonstration of how much the appearance of blue sky can change just by choosing different Picture Styles. I was recently thinking about this issue on a glorious blue sky afternoon in Tasmania when a Virgin airliner flew past. I snapped a few flight shots as it seemed like the perfect set-up; the aircraft has a lot of white livery to enable the exposure and white balance to be adjusted and the sun angle was ideal for directly illuminating the side of the white fuselage (see Figure 3). In post-processing I fine-tuned the brightness and white balance with the white parts beginning to saturate at 255 DN. Then I took a 512 × 512 pixel selection of blue sky near the aircraft and measured the mean RGB numbers for the selection with Picture Style = Neutral, Standard and Landscape. The selections are shown in Figure 4 (see next page) together with the blue sky standard. The closest match to the blue sky standard is the colour panel processed with Picture Style = Neutral. It is not a perfect match because the aircraft was not overhead but at an elevation of about 45° where there is more light due to Mie scattering causing the sky to appear slightly brighter. Picture Style = Standard has more saturation but is probably still acceptable to most people. However, Picture Style = Landscape results in too much saturation and to my taste is an unacceptable rendering of blue sky.

I hope these notes help members finish their images with blue sky backgrounds that are natural looking. It may seem like a small point but it can make a big difference to how an image is perceived, especially by knowledgeable critics and judges. Once you become aware of the issue your eye will become more sensitive and you may be surprised at how many images have been finished with no regard for how natural the blue sky background looks.



Blue Sky Standard
R = 98, G = 122, B = 157 DN

Canon 5Ds, Picture Style = Neutral
R = 94, G = 126, B = 169 DN

Canon 5Ds, Picture Style = Standard
R = 88, G = 133, B = 177 DN

Canon 5Ds, Picture Style = Landscape
R = 67, G = 121, B = 193 DN

Figure 4. A practical demonstration of how the appearance of blue sky changes with the Picture Style for images captured with the Canon 5Ds. We can expect similar changes with other cameras.